

MEDIATING EFFECT OF ENTERPRISE RISK MANAGEMENT  
IMPLEMENTATION ON OPERATIONAL EXCELLENCE IN THE OIL AND  
GAS INDUSTRY: THE CASE OF NIGERIA

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## DEDICATION

I dedicated this thesis to my dear parents and my loving family for their unwavering support, advice, encouragement and prayers which guided me towards this achievement; I am very proud of them.



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## ABSTRACT

The rising cost of production, risk, environmental concerns and desire to perform, made oil and gas companies adopted operational excellence strategy to remedy the situation. In recent time, incidences on safety and health, the cost of exploration, and ageing facility risks in the Nigerian oil and gas industry are rising. The situation if not checked could lead to a continued decline in oil production, revenue, economic performance and the aspiration of the country to becoming a regional economic force and one of the world's best economies will be unrealistic. It is as a result of this development that this study investigated the mediating effect of enterprise risk management implementation on the relationship between enterprise risk management determinants and operational excellence in the Nigerian oil and gas sector. The study employed a quantitative survey approach, where seven oil and gas companies were chosen purposively for the research and 179 managers and engineers were surveyed, and data were collected via a closed-ended questionnaire. SPSS 23 was used for the preliminary data analysis, and smart PLS-SEM 3.0 was used for the final analysis. The result showed that regulatory framework, firm characteristics, staff capacity and information technology as independent variables had a significant relationship with operational excellence. Enterprise risk management implementation was found to have a significant relationship with operational excellence and also mediates its relationship with firm characteristics and staff capacity. The study findings substantiate the importance of enterprise risk management implementation in operational excellence in the oil and gas sector. The outcome of the research also indicated a theoretical contribution to the body of knowledge of enterprise risk management implementation as well as operational excellence. It also showed practical improvement in the operations of oil and gas sector as regards risk management and operational excellence in the Nigerian oil and gas sector, specifically the Nigerian National Petroleum Corporation.

## ABSTRAK

Peningkatan kos pengeluaran, risiko, kebimbangan alam sekitar dan keinginan untuk melaksanakan, membuat syarikat minyak dan gas mengguna pakai strategi kecemerlangan operasi untuk memperbaiki keadaan. Pada kebelakangan ini, insiden keselamatan dan kesihatan, kos penerokaan, dan risiko kemudahan penuaan dalam industri minyak dan gas Nigeria meningkat. Keadaan ini jika tidak diperiksa boleh membawa kepada penurunan berterusan dalam pengeluaran minyak, pendapatan, prestasi ekonomi dan aspirasi negara untuk menjadi kuasa ekonomi serantau dan salah satu ekonomi terbaik di dunia akan menjadi tidak realistik. Ia adalah hasil daripada perkembangan ini bahawa kajian ini menyiasat kesan pengantara pelaksanaan pengurusan risiko perusahaan mengenai hubungan antara penentu pengurusan risiko perusahaan dan kecemerlangan operasi dalam sektor minyak dan gas Nigeria. Kajian ini menggunakan pendekatan kaji selidik kuantitatif, di mana tujuh syarikat minyak dan gas dipilih dengan sengaja untuk penyelidikan dan 179 pengurus dan jurutera dikaji, dan data dikumpul melalui soal selidik tertutup. SPSS 23 digunakan untuk analisis data awal, dan pintar PLS-SEM 3.0 digunakan untuk analisis akhir. Hasilnya menunjukkan bahawa rangka kerja pengawalseliaan, ciri-ciri firma, keupayaan kakitangan dan teknologi maklumat sebagai pembolehubah bebas mempunyai hubungan yang signifikan dengan kecemerlangan operasi. Pelaksanaan pengurusan risiko perusahaan didapati memiliki hubungan yang signifikan dengan kecemerlangan operasional dan juga mengeratkan hubungannya dengan ciri-ciri perusahaan dan kemampuan staf. Penemuan kajian menegaskan kepentingan pelaksanaan pengurusan risiko perusahaan dalam kecemerlangan operasi dalam sektor minyak dan gas. Hasil penyelidikan juga menunjukkan sumbangan teoritis kepada badan pengetahuan pelaksanaan pengurusan risiko perusahaan serta kecemerlangan operasi. Ia juga menunjukkan peningkatan praktikal dalam operasi sektor minyak dan gas berkaitan dengan pengurusan risiko dan kecemerlangan operasi di sektor minyak dan gas Nigeria, khususnya Perbadanan Petroleum Negara Nigeria.

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## GLOSSARY OF TERMINOLOGIES

OE	Operational Excellence
ERM	Enterprise Risk Management
RFR	Regulatory Framework
SCP	Staff Capacity
IT	Information Technology
FCH	Firm Characteristics
NNPC	Nigeria National Petroleum Corporation
PwC	PriceWaterhouse Coopers
LNG	Liquefied Natural Gas
DPR	Department of Petroleum Resources
KRPC	Kaduna Refining and Petrochemicals Company
PHRC	Port Harcourt Refining Company
WRPC	Warri Refining and Petrochemical Company
NPDC	Nigerian Petroleum Development Company
PPMC	Pipeline and Products Marketing Company
NGC	Nigerian Gas Company
HSE	Health Safety and Environment
PIB	Petroleum Industry Bill



## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

The current global business atmosphere is characterised by unpredictable incidents such as fall in price, rise in the cost of production, new regulations and rising demands from diverse stakeholders. This situation made companies to reinvent their efforts towards understanding, responding and changing strategies to meet up the various economic, social and technical challenges in their environment (Fok-Yew & Ahmad, 2014; Seyed & Markus, 2013). Therefore, it became imperative for firms to re-strategise their business towards excellence to meet up the demands of their stakeholders and the surrounding pressures at all times. Paramount among business excellence elements is operational excellence which is an aspect of organisational structure that strives for developments in crucial operational performance metrics (Shehadeh, Al-Zu'bi & Maqableh, 2016). Operational excellence was necessitated in the Nigerian oil and gas industry to compete globally and the need to come out of the heat the country suffered from the continued drop in oil prices and increase in the cost of production (Chambers, 2017). Also the rising demands from stakeholders (internal and external) for quicker, safer, more consistent, more robust and environmentally all-encompassing production (Ernst & Young, 2015).

Operational excellence (OE) is a strategy adopted by companies to improve and sustain optimal productivity with the efficiency of assets and people. OE program guarantees firm of lower costs of production, increased efficiencies, fewer injuries to staff and the environment, optimal assets yield, and a superior competitive edge (Buckler, 1996). It could, therefore, be said that OE seems to be restricted to

manufacturing operations or service, but it is more ingrained in the oil and gas industries that are working towards operational efficiency than ever before.

## 1.2 Background of Study

The depletion of oil reserves, environmental issues, stiffer regulations, the rise in the cost of production, and the complexity of pricing framework are the current challenges faced by the oil and gas industry (Mustapha, Umeh & Adepoju, 2015). Even capitalspending by the world oil producers shrunk by above 40% or \$280 billion as a reaction to the low oil price regime since 2014 and field decline rates (Perkins & Geller, 2016). Advancement in technologies had led to innovative strides in providing strategies that successfully help upstream operators in their quest for operational excellence to curb most of the challenges in the sector (Bonavita *et al.*, 2008).

Oil and gas industries initiatives assist in building a culture directed towards improving operational effectiveness, integrating business processes and creating an environment that enables the efficiency of capital without compromising safety (Oil&Gas UK, 2018). Thus, the top strategic priority for oil and gas firms remains operational excellence for cost reduction, and health and safety initiatives (PwC, 2017). With operational excellence in place, primary containment loss drops by 40% - 50%, export deferrals declines by 98.5% and emergency and reactive activities reduces by 80% - 90% (McCreery, Philips & Cigala, 2013). It means there is efficient maintenance work for achieving that, hence the need for operational excellence in the Nigerian oil and gas sector.

Integrated Oil and Gas companies had experienced and been affected by the dwindling oil prices, the rise in the cost of exploration and refining, loss of oil in pipeline distribution, shipping and reservoir. Operational excellence was adopted and implemented by some of the oil companies to mitigate the effects of the rising risk in the industry. Statistics credited to Ernst and Young (2015) indicated that 77% of the studied companies have operational excellence (OE) program or have previously run an operational excellence program and 53% of these companies implemented OE across the firm. The study further highlighted that 86% of the integrated oil companies

(IOCs) have an OE or have run one in the past and as for the National oil companies (NOCs), 50% of them from the sampled corporations have never implemented OE program. This indicates the need for OE in the NOCs, as they are the ones that are most affected by these emerging complexity in operations.

Oil and gas is the mainstay of the Nigerian economy. Nigeria is ranked first in Africa and twelfth in the world as a producer of high-value crude oil that has very low sulphur content (Petroleum Technology Association of Nigeria (PETAN), 2016). With oil reserve estimated at 37 billion barrels of oil and 188 trillion cubic feet of gas reserve (Natural Resource Governance Institute (NRGI), 2017). Nigeria attained 42 points out of 100, which made it the 55<sup>th</sup> position amongst 89 resource governance assessments index (RGI) in 2017 (NRGI, 2017). According to DPR (2016) revenues accrued to the Nigerian government from oil and gas proceeds (royalties, concession rentals and miscellaneous) and gas flaring penalties were N1.016trln, N587.6bn and N462.7bn in 2014, 2015 and 2016 respectively. Oil and gas contribution to GDP is third to services and agriculture as it contributed 77% to government revenues and 10.79% of GDP in 2014 (NEITI, 2016).

In spite of the country's position in oil production globally, there are surrounding issues of process wastages due to oil spillage and gas flaring. According to Mustapha *et al.* (2014), the application of lean six sigma operation is overwhelmingly becoming a panacea for driving operational efficiency at all levels in the oil and gas industry. Nigerian oil sector should not be an exception in achieving operational efficiency. Thus, operational excellence as the mother of the lean strategy provides an avenue for reducing cost, health, safety and environmental challenges; it also brings about the reliability of assets and processes. Osteboet *et al.* (2018) opined that HSE, cost control, quality and sustainability are key objectives of the industry; as such it needs a reliable, safe and cost-effective strategy to achieve that.

The Nigerian oil and gas industry had also been renewing efforts to improve on efficiency to reduce production costs across the terrain. In this strive, the sector established a remarkable fabrication and integration infrastructure in-country, on which future deepwater projects could latch to reduce cost, says Ladan, Director, Department of Petroleum Resources (DPR, 2016). It is proven that engineering is done 90% in the country and 50% fabrications of tonnage are also done in Nigeria (PwC,

2014). Nigerian Liquefied Natural Gas (LNG) as a subsidiary of NNPC is an evidence of operational excellence in play. The firm attained transition to stable production operation with a vigorous framework of people, processes, systems and organisation because operational excellence strategy was implemented (LNG, 2017). The strategy improves asset reliability, health, safety, security and environmental performance. Operational excellence (OE) goes further than cost-cutting; it guarantees safe, reliable and efficient operation as business essentials in the oil sector (PwC, 2017). OE is comprised of the safety and health of people, systems, equipment, products, plant, and the environment (Martin, 2015). The challenge in the context of Nigeria remained that there was rarely any standard framework on how compliance and operational excellence are implemented in the NNPC as a group as argued by Mr. Oni, head of research Ecobank (Windham, 2015).

The oil and gas industry struggles with dynamic changes in every sector and at every level, including expanding regulatory oversight infrastructure, cost savings and operating efficiencies have become more critical than ever before (Oracle, 2011). The collapse of oil prices and the rising uncertainties of oil and gas business necessitated the need for standardisation of regulatory framework to improve the performance of the sector in Nigeria (Department of Petroleum Resources (DPR), 2016). Nigeria as a country witnessed rise in geopolitical chaos in the Niger Delta area in the early 21st century, which was managed by the then President Yar'adua in the form of amnesty program (Oke & Kareem, 2013). The problems were issues of vandalism of oil infrastructures, product adulterations, expatriates workers' kidnapping and illegal oil bunkering (Clement, 2018). The same sector faces problems of regulations instability, regulations and policies such as petroleum industry bill (PIB) that was aimed at incorporating 16 different (tax and royalty structure) regulations governing the operations of the oil sector in Nigeria. Similarly, PwC (2014) maintained that the oil and gas sector in the country suffered government interference; regulatory compliance and poor infrastructure amongst others as factors hindering organizations from achieving operational excellence.

Global risk incidents in the oil and gas industry and the Nigerian experience made a significant push to the continuous need for a better way to achieve operational excellence. The event of Deepwater Horizon drilling rig in the Gulf of Mexico in 2010,

BP cherry point refinery fire 2012, Amuay fire and refinery shut down in Venezuela in 2012, and the Pemex pipeline explosion – these accidents serve as caution note to players in the industry about emergencies. These emergencies led to the drop in output, staff morale, loss of assets and the rise in the cost of operation, which directly affects the firm performance of all sort. As a result, they experienced stricter regulations (Ernst & Young, 2015). Regulations on unconventional oil and gas resources – such as the technique for extracting gas from shale, which raises concern about the environment mainly, the water table (Bigliani, 2013).

The present operating model for the oil and gas industry considers risk management as a key ingredient in achieving corporate and strategic objectives (Andeobu *et al.*, 2015). The adoption and implementation of silo risk management models and philosophies have demonstrated its deficiencies in preventing disturbing failures in the oil and gas sector (Bergin, 2010; Davies, 2011). For these reasons, firms in the industry now focused on managing all their risks enterprise-wide (ERM) to achieve their goals and that mission is more disheartening than ever before (Oracle, 2011). This, therefore, had been stressed and that to improve performance in HSE of the sector in Nigeria the risk management strategy must be an all-inclusive enterprise-wide (Dabup, 2012).

The situation in the Nigerian oil and gas sector as found and argued by Zoufa and Ochieng (2014) is worrisome as risk management literacy was poor and an incompetent formation of the risk management team are the most challenging issues bedevilling the sector. From a few years back, massive capital costs and unstable government regulations have affected and created new risk management challenges for the oil and gas sector (Andeobu *et al.*, 2015; Dabup, 2012). The risk management practices in the Nigerian oil sector were largely third-party risk transfer through the insurance companies, even the NLNG (Nwaeke, 2008; Andeobu *et al.*, 2015). On the other hand, health, safety and security program as risk management tools were found to be highly cost-effective than buying insurance cover (Nwaeke, 2008). However, Foster (2000) postulated that health safety and security program manages only those risks that are within the firms' control. Seemingly, there is a need to improve risk management in the sector.



It is true that operational excellence is validated through integrated performance across risk, revenue and cost (Heath *et al.*, 2017). Hence, the interconnectedness of these individual functions automatically sets a firm on a pathway to operational excellence. Summarily put, achieving operational excellence could be influenced by a sound enterprise risk management strategy that aligns with a firm's operational capabilities and the ability to execute this strategy reliably and consistently (Franke & Weber, 2017).

Operational excellence (OE) is concerned with how safe and capable are firm's staff to perform their duties efficiently, how can assets generate more yield compared to the cost of operation and maintenance. It is also concerned with improved productivity by employing recent technology and compliance with regulations (Heath *et al.*, 2017). All these may also depend on which industry a firm belongs to and its characteristics. Equally, in ERM implementation certain factors play a determining role. The determining factors include; regulatory framework; firm size; firm complexity, corporate governance, ERM potential benefits, the emergence of new business trends. Others are the occurrence of certain events, technology and industry characteristics (Salleh Hudin & Abdul Hamid, 2014). From the preceding, ERM and OE seem to be connected in striving to achieve superior performance in the oil and gas industry. Firms that are in a risky business like oil and gas shouldn't see ERM as just a necessity only, but they should look at its implementation as a competitive advantage (Franke & Weber, 2017).

From the preceding, this study, therefore, has taken a direction by applying firm characteristics, staff capacity, regulatory framework and information technology as driving factors to ERM implementation as independent variables and noting that ERM implementation is the mediating variable in the current study. The study is therefore aimed at determining and establishing the relationship between the postulated variables and operational excellence as the subject matter of the study with concern to NNPC subsidiaries.

### 1.3 Statement of Research Problem

Delivering continuous improvement in health, safety, environment and quality performance is one of the mainstays of oil and gas exploration, production and distribution to achieve operational excellence (Chambers, 2017; Ostebo *et al.*, 2018). Oil and gas is the black gold which is expected to garner huge revenues to the endowed nations, through explorations, refining, distribution, and marketing and sales. The current situation of the dwindling oil prices regime had affected oil-dependent nations as well as the performance of oil firms (IOCs and NOCs). Oil and gas companies, primarily upstream operators had witnessed a steady decline in efficiency (the barrel of oil equivalent per day, per capital dollar) and asset reliability due to asset ageing while experiencing increases in finding and lifting costs (Ernst & Young, 2015).

One of the technical challenges is operating and maintaining assets near the end of their lifespan presumably to save cost to the firm, which causes the facility to operate at sub-optimal safety level (Rigzone, 2012). The ageing of the existing assets of the oil and gas companies results in an increased risk of equipment failures, which invariably affects reliability, productivity and employees' safety and health. This has made oil and gas exploration and development more complex and expensive which eventually affects operational performance and also erode revenues and profits targeted by the oil and gas companies. It is evident that Nigerian oil revenues from 2014-2016 dropped from N1.016 trillion to N587.634 billion in 2015 and N462.740 billion in 2016 (DPR, 2016), caused by a consistent drop in production and fall in price.

The problem of inefficiency in the operations of the oil and gas industry is among triggers for the need of an effective operational excellence strategy in the Nigerian oil and gas industry. This was established by a study conducted by Oke and Kareem (2013) in the country's oil sector and found out a high level of inefficiency (technical and cost) of 0.51 between the periods of 2006-2009. This problem still lingers in the sector. The dynamics are taken to improve operation, specifically NNPC in Nigeria was its transformation into a profit-driven enterprise by making the company into a group (Adam, 2014). Again literature revealed that NNPC adopted Total Quality Management (TQM) culture and customer focus as opined by Okoye



(2010), with the drive for quality improvement and low-cost operation. Nonetheless, this effort has failed to transform the corporation quality and low cost orientated operations performance. Also, since the firm's operations key decisions are determined from the centre, according to Adam (2014), these operational decisions are often slow and too much bureaucracy affects operational efficiency and effectiveness of NNPC. This situation still prevails and as such had caused some negative effect on the group's performance and profitability, perhaps the uncertainty on the existence of standard framework for operational excellence was one of the major causes as pointed out by Windham (2015).

Studies revealed that most of the health, safety and environmental incidences were caused by human errors (Alkhaldi, Pathirage & Kulatunga, 2017), equipment failure, faulty designs and inefficiencies in operations management as well as employees' safety and health attitudes (API, 2004). Statistics showed that the trend of health, safety and the environmental (HSE) issues in the Nigerian oil sector is not reducing. Issues related to accident (fatal and non-fatal, work-related and non-work related) as reported by DPR (2016) indicated that 50-57 incidents were recorded in the years 2010, 2011, 2013 and 2016. The trend of incidents is worrisome, as it continued to escalate despite all efforts to curtail it.

Environmental wastes and oil spillage reported by the DPR (2016) also revealed that there were 4850 oil spill incidents and 118,118.65m barrels of oil were released to the environment from 2010-2016. The spillage was largely caused by corrosion of pipelines, vessels, tanks and crude oil handling installations, which are clear case of reliability and integrity of assets. Other causes were preventable failures of oil facilities/equipment, operational errors due to human interface and third-party intervention (vandalisation, oil bunkering/theft). The situation needs to be permanently brought down to the barest minimum for the sector to perform. There were also 741,495 barrels productions deferment cases caused by unplanned plant shut down necessitated by vandalization of facilities and operational challenges (DPR, 2016). Consequently, there was 9.6% decline over the average production rate for 2015. In the same way, the NNPC refineries were performing below capacity, to as low as 5.43% - 15.52% in 2014-2016 (DPR, 2016). This under-capacity performance of the refineries (KRPC, WRPC and PHRC) was a serious operational problem, which

affected output and revenues generation and by extension affected the efficiency of the firm as a group. It also increased the cost of operation and maintenance, which were perhaps due to lack of clearly adopted framework for operational excellence in the oil and gas sector.

Over the years, both experts and scholars have conducted studies on operational excellence in manufacturing, service and oil and gas sectors. Majority of the few studies conducted on operational excellence were from manufacturing and service industries and little in oil and gas industry. On the theoretical note, they were concentrated on human resources practice, leadership, strategy, change management, culture (Fok-Yew, Ahmad & Baharin, 2014a; Fok-Yew & Ahmad, 2014b; Shehadeh, Al-Zubi & Maqableh, 2016b; Soliman, 2016; Sung & Choi, 2011; Jalil, Shaikh & Alam, 2014; Parast, Adams & Jones, 2011) and knowledge management; operational efficiency (Oke & Kareem, 2013); administrative system, staffing, financial process and control mechanism (Adam, 2014); lean production, service delivery (Uzochukwu & Ossai, 2016); level of OE implementation (Ifeanyichukwu, 2010); information, knowledge and process integration (Amue & Ozuru, 2014); and government interference, inadequate infrastructure, fraud and corruption, regulatory compliance issues (PwC, 2014). All the studies were done in Malaysia, Jordan, Egypt, Bangladesh, South Korea and Nigeria.

Other group of studies concentrated on information technology, (Ratna & Kaur, 2016; Wilson *et al.*, 2015; Amue & Ozuru, 2014; Wang, Chen & Benitez-Amado, 2015; Ward & Zhou, 2006) firm characteristics like size, ownership, markets, complexity and assets (Hartley & Medlock, 2012; Kheni, Dainty & Gibb, 2008; Grace, Leverty & Shimpf, 2010; Kisengo & Kombo, 2012; Gordon, Loeb & Tseng, 2009; Anderson *et al.*, 2004; Yazid, Razali & Hussin, 2012; Hoyt & Liebenberg, 2008; Waweru & Kisaka, 2012), however some of them were used as moderating and control variables (Ping & Muthuvelo, 2015; Wang *et al.*, 2015). Majority of the second set of studies used a quantitative research design and were conducted in North America, USA, Canada, Kenya, Ghana and India.

Some studies considered the effects of regulations, regulatory agencies and enforcement on OE (Ramanathan *et al.*, 2017; Bolu, 2011; Viscusi, 1986), the studies were done in the context of UK and USA. The researchers used quantitative designs

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